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ELECTRICITY IN THE PRODUCTION OF QUALITY MILK

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University of Georgia, Athens, Georgia, August 8, 1939.

The first thing I did when I started to prepare this talk was to assure myself that I knew what constitutes quality milk. I've tasted some milk that had quality all right - I can almost taste it yet. Probably that wasn't the quality Professor Driftmier had in mind when he wrote me about this Farm and Home Week program. I looked through the Milk Ordinance recommended by the United States Public Health Service to get the correct definition of Grade A milk. Here it is:

> "Grade A raw milk is raw milk the average bacterial plate count of which as determined under sections 1 (S) and 6 of this ordinance does not exceed 50,000 per cubic centimeter, or the average direct microscopic count of which does not exceed 50,000 per cubic centimeter if clumps are counted or 200,000 per cubic centimeter if individual organisms are counted, or the average reduction time of which is not less than 8 hours, provided that if it is to be pasteurized the corresponding limits shall be 200,000 per cubic centimeter, 200,000 per cubic centimeter, 800,000 per cubic centimeter, and 6 hours respectively; and which is produced upon dairy farms conforming with all of the following items of sanitation."

I'm not going too fast, am I? In defining Grade A milk I've assumed that all of you know what I'm talking about. I'd be very much surprised if any of you would be taking time to listen to me if you don't even know what milk is. But do you? Can you define it? Well, I'm not going to ask you to do that, but let me give you the

definition given in the recommended Milk Ordinance:

> "Milk is hereby defined to be the lacteal secretion obtained by the complete milking of one or more healthy cows, excluding that obtained within 15 days before and 5 days after calving, or such longer period as may be necessary to render the milk practically colostrum free; which contains not less than 8 percent of milk solids not fat, and not less than 3-1/4 percent of milk fat."

Now that we know what milk is and have Grade A milk properly defined, let us see what equipment is required and what precautions are necessary to produce it. We are told that a good workman can produce good results with few and relatively poor tools and that a poor workman will do a bad job even with good tools. That may be true, but somehow or other good workmen soon collect good tools and poor workmen soon let good tools run down. Maybe it is by good management that quality milk is produced, but quality milk is produced a lot easier with good equipment than with poor.

There are two parts to the production of quality milk: The first is that the dairyman must start with quality milk, and second, the milk must be kept good. No amount of equipment, or doctoring, will make good milk, butter or cheese from poor milk. Assuming that the farmer has good cows, and that by good management they produce good milk, what tools are available to help him keep that milk good and put a quality product on the market? There are many in this modern age. Good barns, properly designed milk houses, reliable feed and milk handling equipment, and efficient cooling and sterilizing facilities are only a part of the list. I am naturally interested in the part that electricity plays, or may play if given an opportunity, in the production of quality milk.

We haven't time to enter into that old argument as to whether it was the hen or the egg that came first, but must start somewhere, so let us start with the feed. The cheapest and best feed the cow can eat is good pasture grass. She harvests and does all the processing herself. Good pasture depends upon a sure and bountiful supply of water as well as fertilizer and management. Nature is kind but nature is severe. When rain does not fall everything, including the pasture, the cows and you, suffer. We don't have droughts every year, neither do we have a devastating fire every year, yet we pay insurance annually. Why not insure the pasture? Supplemental irrigation is the insurance. Of course, there is the cost of the equipment, but the cost of operation is nothing when the plant is not needed and does not operate.

A recent survey of the uses of electricity in the dairy industry showed that only six of the states east of the Mississippi River have tried or even thought seriously of irrigating pastures. I don't know what your record dry period is. A look at the rainfall map of Georgia does not indicate a general need for supplemental irrigation.

Naturally, a general recommendation to irrigate even during dry spells cannot be made. There are local problems that must be considered, such for example as source of water, availability of power at the source, height to which the water must be lifted, cost of equipment, etc. The amount of water required to sustain growth of pasture grass is around one inch every ten days.

While we are thinking of pastures the electric fence comes to our mind. The use of this device has been growing rapidly if we may

believe reports concerning it. We answer several letters every week from persons wanting information on electric fences. Their principal application, as I see it, is in the control of pasture rotation lots. Fence controllers have not, to the best of my knowledge, been approved by Underwriters' Laboratories and electrical inspectors are likely to look with disfavor upon them until they have the stamp of approval of that organization. Every now and again we read of a fatal accident through contact with an electric fence. Most of these have been with home-made devices or with wires connected directly to the lighting circuits. This is not universally so, however. My recollection goes back very vividly to November 11, 1937 when a high-school boy was killed by coming into contact with an electric fence wire near Toppenish, Washington. The controller in this case was a commercially manufactured one.

The principal reason that Underwriters' Laboratories have been backward about making recommendations concerning them is that no one has been willing or able to say how much electricity or in what form, may be considered a safe upper limit. It is now generally believed that the current output of the controller should not exceed 10 to 12 miliamperes (or 10 to 12 thousandths of an ampere). That means some rather small values and does not admit much latitude in design. It is unsafe to use home-made devices and one should consult state authorities and ascertain the legality of using them before purchasing.

Let us go into the barn and see how electricity may help there. Silage cutting is another application of electricity in the production of milk. I don't know how much Georgia farmers must depend upon stored

feed; maybe not at all, but farther north the handling of silage is no small part of harvesting operations. Although the electric motor is not used much because the tractor with its belt power take-off is already available, the electric motor has proved satisfactory on small cutters, and should not be overlooked where tractors are not used or are likely to be busy at other jobs when silage should be cut.

Hay cutting is practiced some, but the value of cutting or chopping hay is still a controversial matter, and who am I to give advice when doctors disagree? It seems to have its greatest value in high priced hay or in lean years when hay is scarce. Stock clean it up better than they do ordinary hay. It apparently has no greater feed value, but when the cost of cutting is less than the value of the ordinary hay wasted it may be good economy to cut it. It will pack into about half the space required for uncut hay. On the red side of the ledger we find that pieces of nails and wire in cut hay are frequently picked up and swallowed by cattle with disastrous results.

Electrically powered hay hoists are not much used but are very well liked by those who have and use them.

Feed grinders and mixers lend themselves to electric drive. They have a definite place where the grain is raised on the dairy farm. Unfortunately they are not much used. Some are driven by tractors. One reason for this is, of course, that there is no need to duplicate power, and when the tractor is available why not use it? Another reason is that we simply have not learned that everything does not have to be done at once. We buy big equipment, use it a few hours and let it stand idle for several weeks. Why not buy smaller equipment, use it

longer, invest less and run it with a reasonably small electric motor?

There are now on the market small hammer mills that will grind half a ton of grain per hour with 1-1/2 horse-power electric motors. These mills may be set under hoppers and arranged for automatic feeding, thus allowing the dairyman to go about his regular chores. The cost of this mill and motor complete is around $125. Medium to coarse grinding is best for most purposes and for such grinding about one-half kilowatt hour of electrical energy will be required per hundred pounds of feed. Burr mills will cost slightly less than hammer mills and may be obtained in smaller capacities, but as a rule do not lend themselves to automatic feeding as do hammer mills. Roller mills are used more in preparing feed for horses but are fairly popular among the feed grinders used in the Pacific Northwest.

Mixing and elevating as well as grinding belong to feed processing and handling. Automatic feeding devices and smaller machines with lower capacity motors operated over longer time are claimed to be more economical than large ones. Equipment costs are less, the load factor on the electrical system is higher and the cost of energy less. Necessarily equipment suitable for this type of operation must be selected with judgment. We should suit our equipment to our needs as well as fit our shoes to our feet.

Another use of electricity in the production of quality milk is that required to operate the water system. To discuss the water system thoroughly would require all the time allotted to this paper. It does not, however, require any stretch of imagination to see how the water system, pump, motor, and other parts, contribute to the production of

good milk. A very large percentage of milk is water and the cow must drink plenty of it if she produces heavily. The water system not only furnishes the water necessary for cleansing utensils but leaves the farmer more time in which to do a thorough job by releasing him from the pump handle or worse still, the windlass.

What capacity water system to buy necessarily depends upon climatic conditions, the size and kind of herd and what other uses you may have for the water. Let us say it will require on an average 7 gallons per gallon of milk in the surface cooler, or 20 gallons per cow per day, and 30 gallons per cow per day for the refrigerator condenser; then suppose the cow drinks on an average 25 gallons per day. Some will be needed for washing, scrubbing, sterilizing, the amount depending somewhat upon the size of herd. It would not be exaggerating to say that between 80 and 100 gallons per cow per day will be needed.

From these figures, which are average, it is seen that for a ten-cow herd 800 gallons of water will be required per day. About the smallest outfit of this type on the market has a capacity of 175 gallons per hour. The cost will vary from around $60 to $100 depending upon the depth of the well. The piping and plumbing will be in addition. An alternative to the automatic pump just mentioned is a pump jack which may be attached to the standard force pump.

The milking machine is another tool for the dairyman and does not belong to the class of devices designed for the pleasure of the mechanically minded, although there is certainly a limit to its economic

usefulness. Certainly a farmer with only three or four cows could not use one economically. Perhaps 15 cows would be a good number with which to start. How does the milking machine help produce high-grade milk? We hear a great deal about how difficult it is to keep it clean. Well, it does add to the work of cleaning, if it is cleaned properly. That is one reason why it isn't profitable to use on a small herd, but if the time and cost of using an extra man to help milk are considered, it may be economically feasible to buy and use one.

The cost of operating a milking machine will depend somewhat upon the size of the herd. Records in Oklahoma show an average of 1.63 kwhr. per cow per month and 2.93 kwhr. per 1000 pounds of milk with an average herd of around 39 cows. In Texas with 35-cow herds the average was 2.56 kwhr. per cow per month and 4.5 kwhr. per 1000 pounds of milk. A study made twelve years ago on a number of Washington dairies showed an average of 3.8 kwhr. per cow per month. Note that in that time the energy requirement has been reduced about one-half.

When properly handled and cared for the mechanical milker does not contribute to high bacteria count nor is it responsible for spread of mastitis, the loss of quarters, or other physical injury. In general it should be considered as a labor saver, rather than a contributor to high quality milk, but properly handled it may be both.

Let us follow the milk to the milk house and see how electricity helps there. The first job is cooling. There are two distinct methods of doing this. One is by use of an aerator and the other is by use of

an immersion cooler. No matter which way it is done the objective is the same - to reduce the temperature of the milk and check the development of bacteria. To do a good job of checking bacterial development the temperature should be reduced to 50° F or less within two hours after it is drawn. The dairy specialists at Pennsylvania State College think that we shall soon be saying 40° F.

Milk cooling plays such an important part in the production of a quality product that I should like to dwell upon it for a minute or two. Milk, when drawn under sanitary conditions, usually contains from one million to ten million bacteria per quart. Of course, very few of these may be of a harmful type beyond the fact that they cause the milk to sour, but it is the few harmful ones that must be watched. Bacteria are minute plants which grow very slowly or not at all at temperatures below 50° F.

As previously mentioned, there are two methods of cooling milk. There are two ways of using these methods: The first is by means of ice or cold water and the other is by means of mechanical refrigeration. Any mention I shall make of milk cooling is by means of mechanical refrigeration. Mechanical refrigeration is by far the most reliable and fortunately is being adopted rapidly.

The surface cooler and the immersion tank were mentioned. Your questions quite naturally are: What are the advantages of each, which one should I buy, and what do they cost? I cannot answer the cost question. So much depends upon the make, size and quality. The aerator or surface cooler is used most by the producer-retailer. The farmer who produces for the creamery or the distributor frequently holds the

milk for longer periods and may just as well let one piece of equipment do both the cooling and keeping, which the surface cooler does not do. Therefore he uses an immersion cooler. I should like to refer you to U.S.D.A. Farmers' Bulletin No. 1818, Mechanical Milk Cooling on Farms.

Another aid to the production of quality milk is the utensil sterilizer. The sterilizer is not the washer, but regardless of how carefully the washing may be done sterilizing must be done if the utensils are to be even reasonably free from bacteria. Electric sterilizers have not been accepted wholeheartedly by dairymen because of their cost and because few of them produce the hot water necessary for thorough washing. They do work, however, and in due time will take their place along with other electrical equipment in the milk house.

I will merely name a number of other appliances - the bottle washer, the bottler, separator, churn, and, in larger dairies, the pasteurizer, homogenizer and freezer.

We are interested in the use of electrical equipment in the dairy industry for two reasons: First, we believe it makes life on the farm more pleasant and relieves the farmer of some mighty hard work; second, it will, when intelligently used, help him improve the quality of his product. We believe also that the thoughtful application of electricity on the dairy farm, or even on the general farm where a few cows are kept, will be self-supporting. It is to develop or discover economically sound applications that the rural electrification investigations unit was organized in the Bureau of Agricultural Chemistry and Engineering. It is largely in the interest of that project that

I am here. We know electricity must pay its own way if it is to be used on many farms. We hope that means may be found for making it do as good a job on the general farm as it has on the poultry and dairy farms.

I have never had much of a sympathetic ear for the high pressure salesman, but I am beginning to believe the conscientious agent has his place. We are all slow to buy new things and slower still at adopting new ideas and methods of doing things. In adopting many of these electrical appliances we are obliged to learn new methods and often re-plan our schedule of doing things. Why is it that a new device will fail for one and prove valuable for another? Frequently it is because one man can adjust his plans to suit the requirements of the thing and the other cannot. If the appliance does not fit into one's scheme of doing things it fails and ends its career on the scrap heap. Although man was almost able to retain his walking habits when he made the bicycle, he had to learn to sit while traveling when he reached the airplane stage. It didn't hurt him any and he is able to get there and back while he would be only getting nicely under way were he to walk or ride the "bike". We may find it to our advantage to change our way of doing things completely if we are going to use some of these new tools to the best advantage. I do not preach that adoption of these appliances will enable you to sit in the shade while they do the work. They may not even reduce the amount of work you do, but they should, if properly handled, improve the quality of your product, and, as a result, net greater returns for your labor.